CLAIMS

1.   A laser processing apparatus for irradiating a wafer-like object to be processed with laser light while locating a light-converging point within the object so as to form a modified region by multiphoton absorption within the object, the apparatus comprising:

        a beam expander for enlarging a beam size of the laser light emitted from a laser light source;

        a condenser lens for converging the laser light incident thereon by way of the beam expander into the object; and

        a lens holder holding the condenser lens and including a first light-transmitting hole for making the laser light incident on the condenser lens;

        wherein a stop member having a second light-transmitting hole for narrowing and transmitting the laser light is disposed on an optical path of the laser light connecting the beam expander and the first light-transmitting hole to each other and is separated from the lens holder.

2.   A laser processing apparatus according to claim 1, wherein, when the laser light emitted from the beam expander is substantially parallel light,

        the second light-transmitting hole has a diameter not greater than that of the first light-transmitting hole.

3.   A laser processing apparatus according to claim 1, wherein, when the laser light source emits the laser light at a beam diameter φ_0 and a divergence angle $2\theta_0$, and the beam expander enlarges the beam size of the laser light by a magnification M and emits the laser light at a divergence angle $2\theta_1$;

        assuming that d_1 is the distance between an exit part of the laser light source and an entrance part of the beam expander, d_2 is the distance between an exit part of the beam expander and an entrance opening of the second light-

transmitting hole, and d_3 is the distance between the entrance opening of the second light-transmitting hole and an entrance opening of the first light-transmitting hole; and

letting φ_L be the diameter of the first light-transmitting hole, and φ_S be the diameter of the second light-transmitting hole;

φ_L and φ_S satisfy the relationship of

$$\frac{\phi_L \left\{ M\left(\phi_0 + 2d_1 \tan\theta_0\right) + 2d_2 \tan\theta_1 \right\}}{M\left(\phi_0 + 2d_1 \tan\theta_0\right) + 2\left(d_2 + d_3\right)\tan\theta_1} \geq \phi_S.$$

4.   A laser processing apparatus according to claim 1, wherein, when the laser light source emits the laser light at a beam diameter φ_0 and a divergence angle $2\theta_0$, and the beam expander enlarges the beam size of the laser light by a magnification M and emits the laser light at a convergence angle $2\theta_1$;

assuming that d_1 is the distance between an exit part of the laser light source and an entrance part of the beam expander, d_2 is the distance between an exit part of the beam expander and an entrance opening of the second light-transmitting hole, and d_3 is the distance between the entrance opening of the second light-transmitting hole and an entrance opening of the first light-transmitting hole; and

letting φ_L be the diameter of the first light-transmitting hole, and φ_S be the diameter of the second light-transmitting hole;

φ_L and φ_S satisfy the relationship of

$$\frac{\phi_L \left\{ M\left(\phi_0 + 2d_1 \tan\theta_0\right) - 2d_2 \tan\theta_1 \right\}}{M\left(\phi_0 + 2d_1 \tan\theta_0\right) - 2\left(d_2 + d_3\right)\tan\theta_1} \geq \phi_S.$$

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